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ISOLATION AND STRUCTURE OF ACORAGERMACRONE

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Recently, many sesquiterpenes have been isolated from the rhizomes of Acorus calamus L (Japanese name "Shyobu") growing in Japan.[1,2,3] From a biogenetic point of view, acoragermacrone (I) must be regarded as a common intermediate of these sesquiterpenes.[1,3] Accordingly, further investigation on chemical constituents of Acorus calamus L together with synthetic studies on the germacrone-type compound (I) has been continued in our laboratory. In the present paper, we wish to describe the isolation and structure of acoragermacrone (I)

According to essentially the same procedure as reported in the previous paper,[3] the sliced raw rhizomes of Acorus calamus L were pluverized with a mixer and carefully extracted with large amounts of *n*-hexane to give a brown oil,[4] which was directly chromatographed on silica gel (Kanto Chemicals Ltd., 100 - 200 mesh). Rapid elution with *n*-hexane - ether (3 : 1) afforded a mixture of acoragermacrone (I) and preisocalamendiol (II).[1,5] Further separation of this mixture was successfully carried out by repeated preparative TLC using alumina [GF_{254} (Type E), E. Merck A.G., Darmstadt] in *n*-hexane - benzene (2 : 1) to give acoragermacrone (I) and preisocalamendiol (II) in each pure state [I, *ca*. 6% yield; II, *ca*. 18% yield (from the *n*-hexane extracts)]. The physical properties of acoragermacrone thus obtained are described below.

Acoragermacrone (I). $C_{15}H_{24}O$ (m/e 220 (M^+)), ν_{max}(film) 1680 and 1607cm^{-1}; λ_{max}(MeOH) 242nm (ε, 6590); $\delta(C_6D_6)$ 0.94(3H, d, J= 5.7Hz), 1.02(3H, d, J= 5.7Hz), 1.12(3H, d, J= 1.5Hz), 1.97(3H, d, J= 1.0Hz), 4.60(1H, br.m) and 5.33ppm(1H, q, J= 1.0Hz).

As shown above, acoragermacrone (I) is a colourless liquid having a molecular

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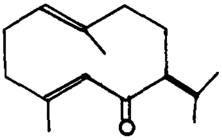
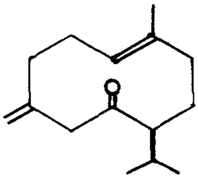
formula ($C_{15}H_{24}O$). The IR and UV spectra of it coupled with the NMR signals at δ1.97 (3H, d, J= 1.0Hz) and 5.33ppm(1H, q, J= 1.0Hz)[6] indicate the presence of an $\alpha\beta$-unsaturated cisoid carbonyl system (Me-$\overset{\downarrow}{C}$=CH-$\overset{\downarrow}{C}$=O). This is also confirmed by chemical evidences, as described later. Furthermore, acoragermacrone (I) also has an isopropyl group as well as a methyl group attached to a trisubstituted double bond [δ1.12(3H, d, J= 1.5Hz) and 4.60ppm (1H, br.m)],[7] as found in the case of preisocalamendiol (II). In particular, the appearance of the methyl signal in unusually higher magnetic field (δ1.12ppm) seems to be due to the anisotropy effect of the $\alpha\beta$-unsaturated carbonyl system.

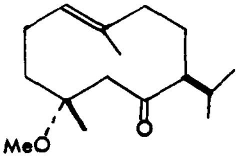
When treated with MeONa - MeOH (room temp., 30min), acoragermacrone was converted into the corresponding methoxy-ketone (III) in 48% yield, $C_{16}H_{28}O_2$ (m/e 252 (M^+)); ν_{max}(film) 1705 and 1640cm^{-1}; $\delta(C_6D_6)$ 0.79(6H, d, J= 6.0Hz), 1.41(3H, s), 1.53(3H, s), 2.46(1H, d, J= 17.7Hz), 2.98(3H, s), 3.03(1H, d, J= 17.7Hz) and 5.40ppm(1H, br.m). From the IR and NMR spectra [δ1.41(3H, s), 2.46(1H, d), 2.98(3H, s) and 3.03ppm(1H, d)] it is clear that III has a partial structure [Me-$\overset{\downarrow}{C}$(OMe)-CH_2-$\overset{\downarrow}{C}$=O]. Furthermore, it should be noted that the methyl signal at δ1.12ppm in I is shifted to δ1.53ppm in III. Finally,



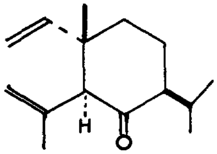
(I)



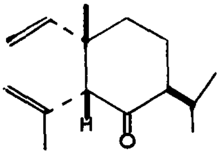
(II)



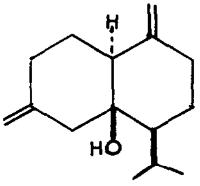
(III)



(IV)

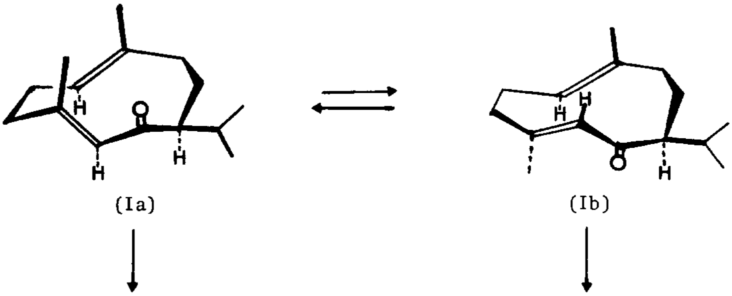


(V)



(VI)

acoragermacrone (I) was converted into shyobunone (IV) and epishyobunone (V), as discussed below. Although acoragermacrone in a sealed tube was heated at 80°, the starting material was recovered. However, when heated at 110° for 30min, I was completely converted into IV and V (relative ratio: IV/V = 21/4).[1,8] In the above experiment, shyobunone (IV) and epishyobunone (V) both must be directly formed from I, since these two elemene-type compounds are quite stable under the same condition. Therefore, acoragermacrone (I) has two possible conformational isomers (Ia and Ib) at least at 110°. IV must be formed from Ia, whereas V can be derived from the latter, as shown below. Under more vigorous conditions, shyobunone (IV) has been known to be converted into preisocalamendiol (II) and dehydroxyisocalamendiol (VI) through acoragermacrone (I).[9] Further studies on this point are in progress.



(Ia) (Ib)

Shyobunone (IV) Epishyobunone (V)

All compounds gave satisfactory physical data, and their structures were confirmed by IR, UV, NMR and mass spectrometric data.

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REFERENCES AND FOOTNOTES

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2. H. Minato, R. Fujioka and K. Takeda, Chem. Pharm. Bull. Japan, **19**, 638 (1971).
3. M. Niwa, A. Nishiyama, M. Iguchi and S. Yamamura, Chemistry Letters, 823 (1972).
4. Collected at Toyoda-shi, Aichi-ken in the middle of november.
5. This mixture was obtained after elution of shyobunone (IV) and its isomers.
6. Irradiation at δ 1.97ppm caused the quartet at δ 5.33ppm to collapse to sharp singlet. In the case of irradiation at δ 5.33ppm, the methyl doublet at δ 1.97ppm became sharp singlet.
7. Irradiation at δ 4.60ppm caused the methyl doublet at δ 1.12ppm to collapse to sharp

singlet.

8. Peak area of gas-liquid chromatogram (5% PEG 20M on Celite 545, 95°, N_2, flame-ionizer detector) was served as an approximate value of content (%).

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